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Dr. C. E. Winters

June 14, 1949

Mr. L. B. Emlet

Paper for Stack Gas Working Group Meeting

Attached is a draft of the paper on "Radioactive Air Contaminants from Chemical Separations Processes". Mr. E. J. Witkowski was originally scheduled to present this talk, but since he is on vacation someone will have to substitute. Mr. C. P. Coughlen has done most of the work. You may wish to ask him to handle this assignment. If he does not wish to participate, I will be glad to act as Mr. Witkowski's stand-in.

It is my understanding that you will compile this paper with the others and issue a complete report on the meeting.

ORIGINAL SIGNED BY
L. B. EMLET

L. B. Emlet

LBE:wp

1. C. E. Winters
2. C. P. Coughlen
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4. Harris Blauer
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D R A F T

(6-14-49)

RADIOACTIVE AIR CONTAMINANTS FROM CHEMICAL SEPARATIONS PROCESSES

(Paper for oral presentation before Stack Gas Working Group-ORNL - June 21 and 22, 1949)

The output of radioactive particulate matter from the various chemical separations processes remains the major contributor to area contamination. We have in the past six months taken several steps to reduce the quantity of material being released to the atmosphere. I will attempt to outline the various systems in operation and the results of the recent corrective procedures.

It might be well to mention at this point that most of the Laboratory "hot" hoods and some "hot" cell operations continue to be vented directly to the atmosphere. The exhaust air from the hottest of the "hot" hoods has been sampled by C.W.S. filters and a maximum output of 4×10^{-3} mc/hr of gamma activity detected. The average output measured about 10^{-3} mc/hr of gamma activity over a period of six weeks (sampled every three or four days). To date no decontamination facilities are in operation on these installations since there are larger sources of contamination that need our attention.

The Hot Pilot Plant Redox operation, which is located in four cells of the old plutonium pilot plant (Building 205), is a large-scale process using about 400 pounds of Hanford-level uranium per batch. Up to the present time no gas decontamination facilities have been provided. Total activity discharges for one run, which extend over about a four-day period, average less than 10 mc of 1 MEV gamma activity.

It might be well to examine this process very briefly and indicate what we believe to be responsible for the low output of radioactive particles.

1. Most of the Hanford-exposed slugs are allowed to cool for about 120 days before being processed. During this period, the short-lived isotopes, such as I^{131}, which has an eight-day half life and xenon, which has a 5.4-day half life, decay by a factor of 33,000 and 10^6, respectively. Isotopes such as these, which probably contribute the most toward creating problems of gaseous air contamination, are therefore almost entirely eliminated.
2. The Redox process is carried on in twenty process vessels ranging in size from 50 to 3,000 gallons. To prevent the escape of contaminated gases and particles into the cell and ultimately into the operating area, these vessels are under six to eight inches vacuum. This vacuum is provided by means of a steam jet which discharges the gases into the 200-foot stack. As an added precaution, the cell which houses the process vessels is also kept under a one-inch vacuum by means of a 20,000 cfm blower, which also discharges the gases into the same 200-foot stack. You have in effect, therefore, a system where all air flows into the cells and from the cells into the vessels. It is relatively difficult for contaminated gases to escape from the vessels into the working areas. In fact, the vessel off-gas systems here are so efficient that practically no active material is discharged through the cell ventilation.

In our terminology, we refer to a "wet system" as one which handles the gases from dissolver and process vessels and are normally saturated with water or acid vapor. Usually, the "wet systems" are of low volume but contain a high concentration of radioactive gases and particles. The "dry system", on the other hand, refers to the hood and cell ventilation air, which is usually of large volume, but a low concentration of activity.

In the case of the Redox operation, the wet systems have a discharge rate of 100 to 110 cfm. The dissolver off-gases pass through a reflux condenser, while the other process gases vent directly to steam jet and the 200-foot stack. The vessel off-gas line has a flow of about 100 cfm and an activity discharge of about 8 mc per run. The dissolver line handles 10 cfm and an activity of 2 mc per run.

The cell ventilation air of about 20,000 cfm is moved directly from the cells to the stack by a 20,000 cfm, electrically-driven fan (a steam-engine-driven duplicate is provided as standby). Negligible quantities of activity have been detected in this system.

Both of these systems have been proven successful from the standpoint of effectiveness in eliminating air contamination during operations and from the standpoint of trouble-free operation.

The processing equipment for isolating I^{131} from irradiated uranium slugs is located in a cell in the 706-C Building. Although this process handles only 7 pounds of uranium per run as compared to the 400 pounds in the Redox operation, it presents a greater problem of air contamination than does the larger-scale unit emitting $\sim$35 mc per run. One reason for this is the short decay period (only a few hours) of the uranium metal and, consequently, most of the troublesome short-lived isotopes are still present in large amounts.

The process is carried on in seven closed vessels, ranging in size from 16 to 25 liters. The design of the ventilating system used in this process is essentially the same as the one described for the Redox process. The cell itself is kept under a low vacuum to prevent spread of air contamination from the cell into the operating area and the vessels are kept under a higher vacuum to prevent contamination from getting out of the vessel into the cell.

The gases from the process vessels (wet system) are drawn through a condenser and a caustic scrubber by an air jet. The air jet discharges the 50 cfm of vessel off-gases into a line running underground to the 200-foot Redox stack. Various determinations of radioactive particulate matter indicate an average discharge of 20 mc per run of gamma activity. Each run lasts approximately four days.

The cell ventilation (dry system) system has a capacity of about 3,000 cfm. It discharges to a 15-foot stack on the roof of the building. The discharge of this air just a short distance above the roof has not been satisfactory at all times. On several occasions, process equipment failure which permitted some activity to escape from the vessels into the cell ventilating system has resulted in air contamination. In no case has it been serious but it does emphasize the need of a more adequate method for disposing of these gases. This we hope to correct when the ventilating system is tied into the new 250-foot stack recently completed. On two different occasions this cell ventilation system has shown discharges of 15 mc of gamma activity per run.

The isolation of Xe^{135} is a research process which is carried on in laboratory-sized glass equipment located in a concrete cell in Building 706-C. It is one of the smallest, but by no means the least troublesome, of the chemical processes because of the very short half life of the material used.

The wet and dry systems in this process are almost identical to the ones used in the iodine process. The wet system operates on an air jet which discharges 50 cfm into the 200-foot stack, while the dry system discharges 3,750 cfm over the roof of the building. Here the wet system scrubber is apparently less effective than on the I^{131} process, as its discharge has been evaluated as high as 3,800 mc gamma per ten-hour run.

The dry system has caused some degree of air contamination on several occasions when equipment breakage occurred in the cell. Normally, however, the discharge is about 150 mc of gamma activity during a ten-hour run. To temporarily alleviate this condition, the discharge pipe above the roof was extended to thirty feet from its original fifteen-foot level. It is hoped that a completely reliable system will be had when it is connected to the new 250-foot stack.

The production of RaLa in kilocurie quantities is by far the most troublesome of the chemical separations processes so far as area contamination is concerned. It combines both large-scale operation and handling of short-lived fission products.

It is on this process that most of our temporary gaseous decontamination facilities have been installed. Approximately 300 pounds of Hanford-irradiated uranium are processed for a period of about five days once each month. Approximately five days elapse between the time the uranium is discharged from the pile and the time processing is begun here. Because of this short decay period the slugs contain considerable quantities of iodine and xenon.

There are two wet gas systems used for ventilating the process vessels and one dry system used to ventilate the concrete cells where the vessels are located. One wet gas system is operated by means of a steam jet; it draws gases from the dissolver and neutralizer through a reflux condenser, then through a caustic scrubber to remove the active iodine and then through

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an FG-50 glass wool filter (60 sq. ft.) to remove the particulate matter before discharging the gases into the 200-foot stack. The rate of discharge from this system is 35 cfm. Activity discharged per run amounts to about 400 mc gamma after filters (between 500 to 1,000 mc has been detected in the feed to the filters).

The other wet system is operated by means of a 300 cfm blower. The gases from ten other vessels are first processed through an ammonia water scrubber, then through FG-50 glass wool filters (60 sq. ft.) before they are discharged to the 200-foot stack. The rate of discharge from this system is 100-150 cfm. The activity discharged by this system into the stack during each run is about 2,000 mc of gamma activity with the output sharply peaked at certain operations. (Input to filters on two different runs varied from 2,500 to 4,500 mc.)

From the standpoint of operation, both wet systems have only given minor mechanical difficulties which have been overcome. The filters since their installation eight months ago have given no trouble. The glass wool has not yet been changed; the negligible pressure drop (less than 0.05") has not increased appreciably since their installation. However, this type of filter is estimated to be less than 50% effective for such service.

The high output of these systems has been brought about largely by the obsolete type of equipment used in the processing cells. The materials used in this process are extremely radioactive with short-lived fission products but the equipment is not properly sealed to prevent their escape into the cell atmosphere. In some parts of the process, these active materials are actually poured from one vessel to another, very unlike the other processes described where all transfers are made in closed systems. These practices result in gross contamination of the dry cell ventilation air.

The dry system used for ventilating the cells is run by a 15,000 cfm fan. The air drawn out of the cells is filtered through an FG-50 glass wool filter (240 sq. ft.) and a CWS paper filter (400 sq. ft.) before it is discharged to the atmosphere through a fifty-foot stack. The flow through this system is 2,500 cfm.

Since their installation six months ago, these filters have created no difficulty in operation. The pressure drop across the filters has been only 3.6" water and it is anticipated that there will be no need for changing these filters until a new and better system is installed in the near future. Only a slight increase in pressure drop has been noticed since January, 1949. The installation of these filters has reduced the discharge of activity into the atmosphere by a considerable factor. The total discharge from the filter house has averaged about 120 mc of gamma activity per run indicating a filter efficiency of 97%. The dry line discharges for two runs were evaluated before the filters at 2,500 and 15,000 mc of gamma. To correct these conditions, plans have been completed to discharge these gases to the new 250-foot stack and to add other decontamination equipment which will be discussed later.

SUMMARY

1. The hottest of the "hot" laboratory hoods discharge about 10^{-3} mc/hr of gamma activity directly to the atmosphere.

2. The Hot Pilot Plant Redox process discharges about 10 mc/run (four days) through the wet system to the 200 Area stack. The dry system (cell ventilation) contains only negligible quantities.

3. The I^{131} production process releases about 20 mc of gamma activity/run (four days) through the wet system which discharges to the 200-foot stack. About 15 mc of gamma activity have been detected in the dry system which discharges fifteen feet above the roof of the 706-C Building.

4. The Xe^{135} research process releases varying amounts of radioactive particles from 3,800 mc/run maximum through the wet system. This material is discharged up the 200-foot stack. The dry system, which discharges to a 30-foot stack on the roof of the 706-C Building averages about 150 mc/run.

5. The RaLa process in the 706-D Building, which has been provided with temporary gas-cleaning facilities, releases the following quantities of radioactive particles:

WET SYSTEM:	Dissolver off-gas line	- 35 cfm
	Before filter	- 500 to 1,000 mc (estimate)
	After filter	- 400 mc gamma/run
	Vessel off-gas line	- 100-150 cfm
	Before filter	- 2,500 to 5,000 mc (estimate)
	After filter	- 2,000 mc gamma/run
DRY SYSTEM:	Cell ventilation	- 3,000 cfm
	Before filter	- 2,500 to 15,000 mc (estimate)
	After filter	- 120 mc gamma/run

Data by: E. J. Witkowski
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Edited by: L. B. Emlet

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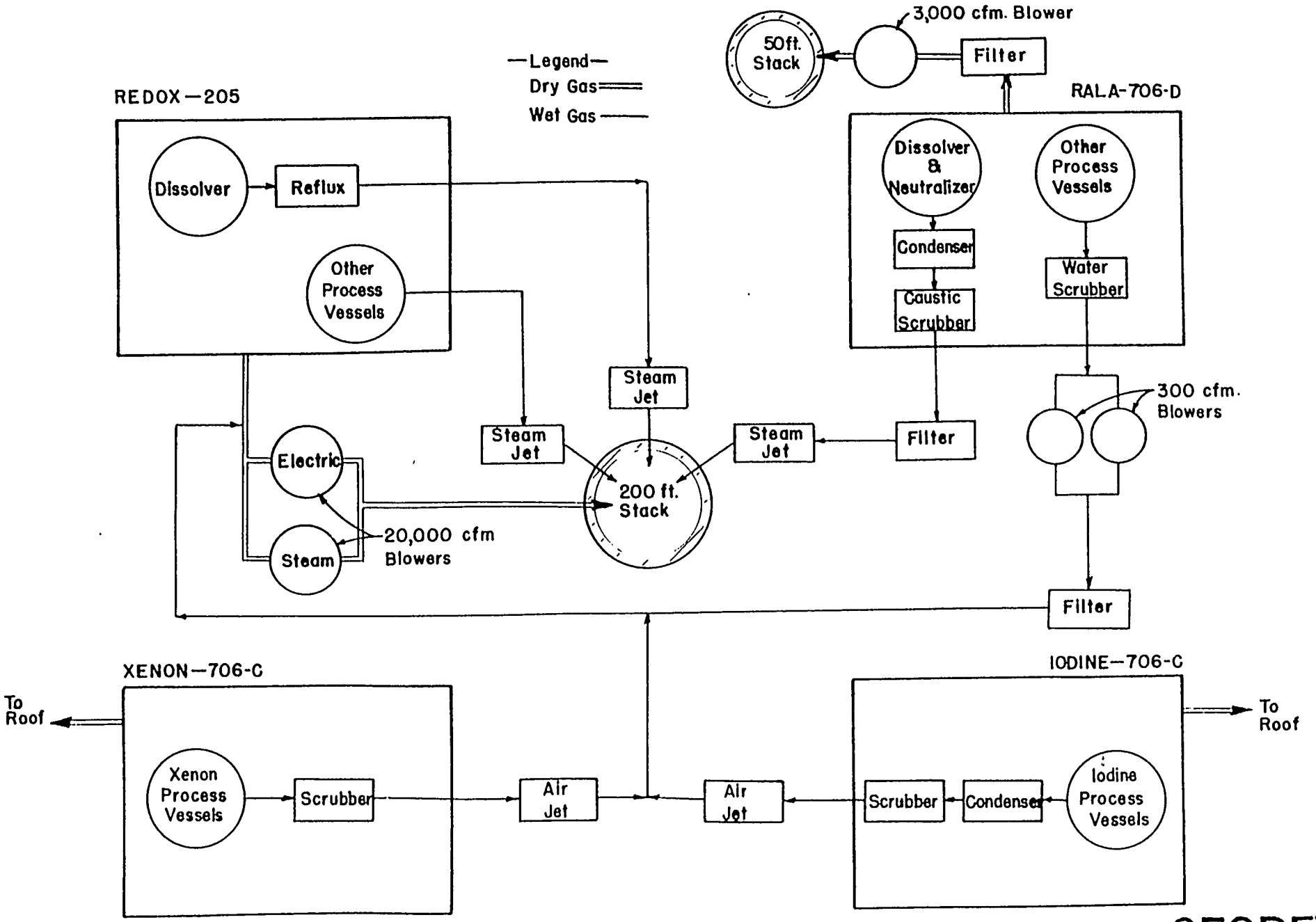
Drawing # 7269

CONTAMINATED AIR EXHAUST SYSTEM



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